PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improved Change Speed Gearing for Tractors

We, MASSEY-HARRIS-FERGUSON (SALES) LIMITED, a British Company, of Fletchamstead Highways, Coventry, Warwickshire, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to change speed gearing for tractors.

The object of the invention is to combine an epicyclic gear with an assembly of gearwheels, which may constitute a conventional change-speed gear, and to provide means for controlling the epicyclic gear so that the combination makes available three speed ranges each consisting of a number of gear ratios selectable at the will of the driver of the tractor.

A tractor having such a wide choice of gear ratios is especially useful for modern mechanised farming. The low range of gear ratios can be adopted for slow heavy work, for instance trailing a combine harvester; the medium range can be adopted for ordinary agricultural work, for instance ploughing; the high range can be used for travelling along roads.

The invention is a tractor change-speed gearing applicable to an output drive and comprising the combination in series with a power-driven assembly of gearwheels, of which selected gearwheels are interengageable and disengageable to give different gear ratios, of an epicyclic gear having for its components a sunwheel, an annulus and a planet carrier with at least one planetwheel, the annulus being stationary and the other two components being rotatable, and clutches for connecting each of said rotatable components with the drive from the gearwheel assembly and with the ouput drive, alternatively, to give increased and decreased speed ranges and for connecting said two drives together through one of said rotatable components to give a medium speed range.

The sunwheel may conveniently be the component utilised for connecting the two drives together for the medium speed range. Alternatively, the planet carrier could be utilised.

An example of change speed gearing embodying the invention is shown in the drawing accompanying the Provisional Specification, which is a mid-sectional elevation of the gearing.

The input of the gearing is an engine-driven shaft 1 with a pinion 2, which is in permanent mesh with a gearwheel 3.

The gearwheel assembly is an orthodox three-speed gearbox of the sliding gearwheel class. The assembly includes a hollow layshaft 4 which is driven by the gearwheel 3. The first, second and third gear ratios are got from pairs of gearwheels 5, 6 and 7, 8 and 9, 10, respectively. The gearwheels 5, 7 and 9 are all pinions on the layshaft 4. The gearwheels 6, 8 and 10 are all slidably fitted on the mainshaft 11 of the gearbox, the shafts 4 and 11 as usual being parallel. The gearwheels 6, 8 and 10 are under the control of a gear-change hand lever 12, of any usual construction, only part of which is shown. The lever 12 is connected through alternatively engageable slide rods 12A, each with a gearwheel-engaging fork; one of these forks is indicated by 12B engaging the gearwheels 8 and 10, which form a single slidable entity. The other fork is similar; it engages the gearwheel 6. The gear-changing operation by means of the lever 12 is customary and therefore need not be described herein.

The output of the entire gearing is a shaft 13, which extends through the customary differential gear and half-axles to the rear ground wheels of the tractor. The epicyclic gear is located between the gearbox mainshaft 11 and the output shaft 13. The epicyclic gear has as its driving element an extension of the mainshaft 11 with a spigot 11A; and it is on this spigot that the epicyclic gear is supported. The spigot 11A projects into a

socket 13A in the adjacent end of the output shaft 13. The gearbox and the epicyclic gear are inter-connected in series.

The epicyclic gear consists of the customary components, namely:—an external annulus; a planet carrier with a number of planetwheels; a central sunwheel. In the example, the annulus is an internally toothed ring 14, which is a fixture, being permanently locked against rotation by any appropriate means (not shown). The planet carrier comprises a pair of spaced rings 15, inter-connected by several bolts, one of them being shown, being indicated by 16. Each bolt penetrates a spacing sleeve 17. Thus, the rings 15 form with the several bolts and spacing sleeves a rigid cage. The planet carrier also includes a number of journal pins 18, there being four of these in the example, each pin bridging the rings 15 and providing a support for one of four toothed planetwheels 19. Only one of these journal pins and its planetwheel are shown. The sunwheel is a gearwheel 20 supported by a bearing 21 on the spigot 11A.

The gearbox mainshaft 11 and the output shaft 13 have clutch devices by operation of which the components of the epicyclic gear can be controlled.

The clutch device with which the shaft 11 is provided is slidably fitted on a portion of this shaft having long clutch teeth 22, this device comprising a short sleeve 24 with internal clutch teeth 23 permanently engaging the teeth 22, this device comprising a short sleeve 24 with internal clutch teeth 23 permanently engaging the teeth 22. The sleeve 24 has a ring of external clutch teeth 25. The purpose of the clutch device 23—25 is to connect the gearbox mainshaft 11 with the sunwheel 20 and with the planet carrier 15, alternatively. Therefore, the sunwheel has a ring of clutch teeth 26 and the planet carrier has a ring of clutch teeth 27 to mate with the rings of clutch teeth 23 and 25, respectively. The clutch device 23—25 is slidable under the control of a fork 28 to clutch the shaft 11 either to the sunwheel or to the planet carrier (as shown).

The clutch device with which the output shaft 13 is provided comprises a slidable sleeve 29 having two rings of clutch teeth 30 and 31. The teeth 30 permanently engage long clutch teeth 32 on the end portion of the shaft 13, on which the clutch device 29—31 is slidable. The purpose of this clutch device is to connect the output shaft 13 with the sunwheel 20 and with the planet carrier 15, alternatively. Therefore the sunwheel and the planet carrier have additional rings of clutch teeth 33 and 34 to mate with the rings of clutch teeth 30 and 31, respectively. The clutch device 29—31 is slidable under the control of a fork 35 to clutch the shaft 13 either to the sunwheel (as shown) or to the planet carrier.

The forks 28 and 35 (each like the fork 12B of the gearbox) are connected to slide rods, of which only the rod 35A of fork 35 is shown. These two slide rods are alternatively engageable by a gear-change hand lever (not shown, being like the hand-lever 12). The arrangement is such that the epicyclic gear can be controlled to operate in any of the following ways, namely:—

High Range. As shown, the gearbox mainshaft 11 is cltuched to the planet carrier 15, and the sunwheel 20 is clutched to the output shaft 13. Thus, the planetwheels 19 roll round the fixed annulus 14 and drive the output shaft 13 at increased speed.

Medium Range. The clutch device 23—25 is slid to the left so that its teeth 23 engage both rings of teeth 22 and 26 and so that the teeth 25 disengage the teeth 27. That is to say, there is established a direct drive from the gearbox mainshaft 11 through the clutch device 23—25, the sunwheel 20 and the clutch device 29—31 to the output shaft 13; and the epicyclic gear is rendered idle.

Low Range. With the clutch device 23—25 set in its left-hand position (as for "medium-range" operation) the other clutch device 29—31 also is slid to the left, so that its teeth 30 continue to engage only the teeth 32 of the output shaft 13, and its teeth 31 move into engagement with the planet-carrier teeth 34. That is to say, the gearbox mainshaft 11 is clutched to the sunwheel 20 and the planet carrier 15 is clutched to the output shaft 13. Thus, the planetwheels 19 roll round the fixed annulus 14 slowly and drive the output shaft 13 at reduced speed.

Therefore, in the combination according to the example, the epicyclic gear provides three ranges of speeds—namely high, medium and low—and the gearwheel assembly provides three speed changes for each range. That is to say, the combination provides nine gear ratios.

In the drawing, only forward driving gearwheels are shown. It will be obvious that, in actual practice, the gearbox as is customary will also incorporate reversing gearwheels.

In the drawing, the hollow layshaft 4 sleeves a shaft 36 which projects beyond the layshaft at both ends. This shaft 36 is the power-take-off shaft of the tractor, being geared in front of the gearwheels 2, 3 to an engine-driven component and extending to the rear end of the tractor.

It will be manifest that the change-speed gearing described attains the object of the invention and that nevertheless, despite the large number of gear ratios available, the construction is simple and compact and will be capable of economic manufacture on a commercial scale.

As described, in the medium range, the direct drive is through the sunwheel 20. Instead, the various clutches may be so positioned that the direct drive is through the

planet carrier 15. In this arrangement, the front clutch device 24 is, as shown, in its forward position clutching the planet carrier 15 through the teeth 27, 25 to the mainshaft 11. The rear clutch device 29 is in its rear position clutching the planet carrier through the teeth 34, 31 to the output shaft 13.

It is a feature of the gearing according to the example that there is no position of either of the clutch devices 24, 29 which can cause conflict between the epicyclic components. That is to say, as regards the device 24, its two sets of clutch teeth 23 and 25 are adapted to pair with the two complemental sets 26 and 27, respectively, and these sets are so related that engagement between either pair is possible only while the other pair are disengaged. The same applies to the device 29 and its two sets of clutch teeth 30 and 31 pairing with the complemental sets 33 and 34 respectively. Each clutch device can safely be set in either of its two positions no matter what position the other clutch device occupies and no matter what position the gearwheels 5 to 10 of the gearbox may occupy. Thus, the two clutch devices can be operated by any usual gear-changing hand levers, without need for any special provisions, such as an inter-locking means, to avoid conflict in the gearing.

It will be apparent that the epicyclic gear may be designed as an auxiliary unit adapted for incorporation in a tractor adapted to receive such a unit but also adapted to work without one. In such an epicyclic unit, the splined portion of the mainshaft 11 would be the input component of the unit and would have a detachable connection with the shaft 11. Correspondingly, the splined portion of the shaft 13 would be the output component of the unit and would have a detachable connection with the shaft 13. The tractor without the unit would have a removable shaft or other connection between the two shafts 11 and 13; and the unit, when incorporated, would be substituted for this connection.

WHAT WE CLAIM IS:—

1. A tractor change-speed gearing applicable to an output drive and comprising the combination in series with a power-driven assembly of gearwheels, of which selected gearwheels are inter-engageable and disengageable to give different gear ratios, of an epicyclic gear having for its components a sunwheel, an annulus and a planet carrier with at least one planetwheel, in which gearing the annulus is stationary and the other two components are rotatable and in which clutches are operable to connect each of said rotatable components with the drive from the gearwheel assembly and with the output drive, alternatively, to give increased and decreased speed ranges and for connecting said two drives together through one of said rotatable components to give a medium speed range.

2. A tractor change-speed gearing according to claim 1, in which the sunwheel can be utilised as the epicyclic component for connecting the two drives together for the medium speed range.

3. A tractor change-speed gearing according to claim 1, in which the planet carrier can be utilised as the epicyclic component for connecting the two drives together for the medium speed range.

4. A tractor change-speed gearing according to any preceding claim, in which a clutch device which is slidably connected with the gearwheel-assembly drive has two sets of clutch teeth adapted to pair with two complemental sets on the two rotatable epicyclic components, respectively, the sets being so related that engagement between either pair of sets is possible only while the other pair are disengaged.

5. A tractor change-speed gearing according to any preceding claim, in which a clutch device which is slidably connected with the output drive has two sets of clutch teeth adapted to pair with two complemental sets on the two rotatable epicyclic components, respectively, the sets being so related that engagement between either pair of sets is possible only while the other pair are disengaged.

6. A tractor change-speed gearing according to claim 5 in which the two sets of planet-carrier clutch teeth are internal, co-operating with complemental external teeth on the respective clutch devices.

7. A tractor change-speed gearing according to claim 5 or 6 in which the two clutch devices have internal teeth which are in permanent sliding engagement with the input and output members, respectively, and which are selectively engageable also with the sunwheel clutch teeth.

8. A tractor change-speed epicyclic gearing, in combination with a power-driven change-speed assembly of gearwheels, substantially as hereinbefore described with reference to and as shown in the drawing accompanying the Provisional Specification.

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PROVISIONAL SPECIFICATION

Improved Change Speed Gearing for Tractors

We, MASSEY-HARRIS-FERGUSON (SALES) LIMITED, a British Company, of Fletchamstead Highway, Coventry, Warwickshire, England, do hereby declare this invention to be described in the following statement:—

This invention relates to change speed gearing for tractors.

The object of the invention is to combine

an epicyclic gear with an assembly of gearwheels, which may constitute a conventional change-speed gear, and to provide means for controlling the epicyclic gear so that the combination makes available three speed ranges each consisting of a number of gear ratios selectable at the will of the driver of the tractor.

A tractor having such a wide choice of gear ratios is especially useful for modern mechanised farming. The low range of gear ratios can be adopted for slow heavy work, for instance trailing a combine harvester; the medium range can be adopted for ordinary agricultural work, for instance ploughing; the high range can be used for travelling along roads.

The invention also is a tractor-change-speed gearing applicable to an output shaft and comprising the combination in series with a gearbox, incorporating gearwheels which are inter-engageable and disengageable to drive a gearbox shaft at different gear ratios, of an epicyclic gear having a stationary annulus, a rotatable sunwheel and rotatable planet carrier with at least one planetwheel, a pair of clutch devices slidably engaging said gear box shaft and said output shaft, respectively, each of said clutch devices having clutch teeth engageable and disengageable with the sunwheel and also having clutch teeth engageable and disengageable with the planet carrier, and means for moving said clutch devices so that the gearbox shaft drives through the planet carrier and the sunwheel to the output shaft to give a high range of speeds, and so that the gearbox shaft drives through the sunwheel and the planet carrier to the output shaft to give a low range of speeds, and also so that the sunwheel or the planet carrier transmits a direct drive between said two shafts to give a medium range of speeds.

The invention is a tractor change-speed gearing applicable to an output drive and comprising the combination in series with a power-driven assembly of gearwheels, of which selected gearwheels are inter-engageable and disengageable to give different gear ratios, of an epicyclic gear having for its components a sunwheel, an annulus and a planet carrier with at least one planetwheel, one of said components being stationary and the other two being rotatable and clutches for connecting each of said rotatable components with the drive from the gearwheel assembly and with the output drive, alternatively, to give increased and decreased speed ranges and for connecting said two drives together through one of said rotatable components to give a medium speed range.

In the preferred construction the annulus is the stationary component.

The sunwheel may conveniently be the component utilised for connecting the two drives together for the medium speed range. Alternatively, the planet carrier could be utilised.

An example of change speed gearing embodying the invention is shown in the accompanying drawing, which is a mid-sectional elevation of the gearing.

The input of the gearing is an engine-driven shaft 1 with a pinion 2, which is in permanent mesh with a gearwheel 3.

The gearwheel assembly is an orthodox three-speed gearbox of the sliding gearwheel class. The assembly includes a hollow layshaft 4 which is driven by the gearwheel 3. The first, second and third gear ratios are got from pairs of gearwheels 5, 6 and 7, 8 and 9, 10, respectively. The gearwheels 5, 7 and 9 are all pinions on the layshaft 4. The gearwheels 6, 8 and 10 are all slidably fitted on the mainshaft 11 of the gearbox, the shafts 4 and 11 as usual being parallel. The gearwheels 6, 8 and 10 are under the control of gear-change hand lever 12, of any usual construction, only part of which is shown. The lever 12 is connected through alternatively engageable slide rods 12A, each with a gearwheel-engaging fork; one of these forks is indicated by 12B engaging the gearwheels 8 and 10, which form a single slidable entity.

The output of the entire gearing is a shaft 13, which extends through the customary differential gear and half-axles to the rear ground wheels of the tractor. The epicyclic gear is located between the gearbox mainshaft 11 and the output shaft 13. The epicyclic gear has as its driving element an extension of the mainshaft 11 with a spigot 11A; and it is on this spigot that the epicyclic gear is supported. The spigot 11A projects into a socket 13A in the adjacent end of the output shaft 13. The gearbox and the epicyclic gear are inter-connected in series.

The epicyclic gear consists of the customary components, namely:—an external annulus; a planet carrier with a number of planetwheels; a central sunwheel. In the example, the annulus is an internally toothed ring 14, which is a fixture, being permanently locked against rotation by any appropriate means. The planet carrier comprises a pair of space rings 15, interconnected by bolts 16. Each bolt penetrates a spacing sleeve 17. Thus, by having several such bolts and sleeves (one only of each is shown) the rings 15 form with them a rigid cage. The planet carrier also includes a number of journal pins 18, there being four of these in the example, each pin bridging the rings 15 and providing a support for one of four toothed planetwheels 19. The sunwheel is a gearwheel 20 supported by a bearing 21 on the spigot 11A.

The gearbox mainshaft 11 and the output shaft 13 have clutch devices by operation of which the components of the epicyclic gear can be controlled.

The clutch device with which the shaft 11

is provided is slidably fitted on a portion of this shaft having long clutch teeth 22, this device comprising a short sleeve 24 with internal clutch teeth 23 permanently engaging the teeth 22. The sleeve 24 has a ring of external clutch teeth 25. The purpose of the clutch device 23—25 is to connect the gearbox mainshaft 11 with the sunwheel 20 and with the planet carrier 15, alternatively. Therefore, the sunwheel has a ring of clutch teeth 26 and the planet carrier has a ring of clutch teeth 27 to mate with the rings of clutch teeth 23 and 25, respectively. The clutch device 23—25 is slidable under the control of a fork 28 to clutch the shaft 11 either to the sunwheel or the planet carrier (as shown).

The clutch device with which the output shaft 13 is provided comprises a slidable sleeve 29 having two rings of clutch teeth 30 and 31. The teeth 30 permanently engage long clutch teeth 32 on the end portion of the shaft 13, on which the clutch device 29—31 is slidable. The purpose of this clutch device is to connect the output shaft 13 with the sunwheel 20 and with the planet carrier, alternatively. Therefore the sunwheel and the planet carrier have additional rings of clutch teeth 33 and 34 to mate with the rings of clutch teeth 30 and 31, respectively. The clutch device 23—25 is slidable under the control of a fork 35 to clutch the shaft 13 either to the sunwheel (as shown) or the planet carrier.

The forks 28 and 35 (each like the fork 12B of the gearbox) are connected to slide rods (not shown) which are alternatively engageable by a gear-change hand lever (not shown, being like the hand-lever 12). The arrangement is such that the epicyclic gear can be controlled to operate in any of the following ways, namely:—

High Range. As shown, the gearbox mainshaft 11 is clutched to the planet carrier 15, and the sunwheel 20 is clutched to the output shaft 13. Thus, the planetwheels 19 roll round the fixed annulus 14 and drive the output shaft 13 at increased speed.

Medium Range. The clutch device 23—25 is slid to the left so that its teeth 23 engage both rings of teeth 22 and 26 and so that the teeth 25 disengage the teeth 27. That is to say, there is established a direct drive from the gearbox mainshaft 11 through the clutch device 23—25, the sunwheel 20 and the clutch device 29—31 to the output shaft 13; and the epicyclic gear is rendered idle.

Low Range. With the clutch device 23—25 set in its left-hand position (as for "medium-range" operation) the other clutch device 29—31 also is slid to the left, so that its teeth 30 continue to engage only the teeth 32 of the output shaft 13, and its teeth 31 move into engagement with the planet-carrier teeth 34. That is to say, the gearbox mainshaft 11 is clutched to the sunwheel 20 and the planet carrier 15 is clutched to the output shaft 13. Thus, the planetwheels 19 roll round the fixed annulus 14 slowly and drive the output shaft 13 at reduced speed.

Therefore, in the combination according to the example, the epicyclic gear provides three ranges of speeds—namely high, medium and low—and the gearwheel assembly provides three speed changes for each range. That is to say, the combination provides nine gear ratios.

In the drawing, only forward driving gearwheels are shown. It will be obvious that, in actual practice, the gearbox as is customary will also incorporate reversing gearwheels.

It will be manifest that the change-speed gearing described attains the object of the invention and that nevertheless, despite the large number of gears ratios available, the construction is simple and compact and will be capable of economic manufacture on a commercial scale.

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